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Uncertainties in the historical land use change emissions, the global carbon cycle and linking to IPCC scenarios

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There are several quite different estimates of historical land use change (LUC) emissions estimates, which are important for balancing the global carbon cycle, calculating regional attribution, and calibrating future scenarios.

We are developing the IVIG model to estimate historical emissions by country using the 300 years land use database from HYDE (History Database of the Global Environment) and FAO areas of agriculture/pasture, coupled with the Java Climate Model (Bern carbon cycle and a simple climate model). This flexible approach facilitates exploration of links between historical and future LUC emissions, consequent changes in the carbon cycle and global temperature, and their sensitivity to various uncertain factors (e.g. biome classification, vegetation and soil carbon factors, carbon fertilization and climate-respiration feedbacks). One important conclusion is that the regional LUC emissions are rather dependent on the biome classification by country.

We compare different historical LUC emissions datasets: IVIG, EDGAR, and Houghton which show quite different global and regional magnitude and trends. The IVIG and EDGAR estimates have the same global emission magnitude in the 1990's (0.5 Gt C), but different regional emissions, however both are different from Houghton (2.1 Gt C). Recent literature based on satellite data shows that the tropical emission in 2000 is about 0.9 Gt C. Regional results also differ from the UNFCCC National Communications, and from the IPCC-SRES scenarios in 2000 (e.g. 1.0 Gt C globally). We explore different ways of deriving future LUC emissions scenarios for countries based

on SRES, combined with stabilisation scenarios and potential biome stocks by region.

Modelled atmospheric concentrations calculated from bottom-up LUC and fossil fuel emissions data, using the Bern carbon cycle in the JCM over the full time scale (1700/2000), can be quite different from each other and the measured data (this is consistent with other studies including complex vegetation models). Such analyses have contributed to an intercomparison of modelling and assessment of contributions to climate change (ACCC/MATCH). We observed that the relative sensitivity of regional LUC emissions to uncertain factors depends on the application (e.g. balancing carbon cycle, historical responsibility and future scenarios).